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Work in Progress - A New Program to Increase High School Students' Interest in Engineering

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Abstract – The United States Coast Guard Academy provides more than 80% of the Coast Guard's engineers. In order to meet Coast Guard needs, the Academy must attract increased numbers of cadet candidates who are interested in and capable of pursuing engineering as a course of study. In July 2004 the Academy conducted a new engineering-focused recruiting program for five hundred high school juniors. Called the Academy Introduction Mission, this summer program brought a diverse group of students from all over the country to New London, Connecticut, for a six-day campus experience. The primary focus of the summer program is an engineering project in which the high school students work in teams throughout the week to build a radio-controlled floating robotic craft. This paper describes this new summer program and its engineering component. The Academy Introduction Mission has increased the engineering and technological literacy of the participating high school students and is expected to improve engineering recruitment and retention.

Index Terms – High school, Engineering forward, K-12, Recruitment, Secondary education.

INTRODUCTION

The United States Coast Guard has identified that it needs to increase the percentage of officers who have engineering degrees. The United States Coast Guard Academy (USCGA) is tasked with having a graduating class that consists of at least 70% technical majors. This requirement is an organizational necessity as USCGA is the primary accession point for Coast Guard engineers.

In an effort to improve recruitment and increase retention of engineering students, two existing summer programs for high school students were recently combined into one program and significantly changed. The first program was known as the Academy Introduction Mission (AIM) and existed primarily to introduce high school students to the rigors of the Academy's military program. The second program was called Minority Introduction to Engineering (MITE) and was designed to introduce minority high school students to the engineering discipline. The new six-day experience was implemented for three diverse groups of high school students from all over the country during three weeks in July of 2004. The summer program retained the name Academy Introduction Mission or AIM. Approximately five hundred

high school students who just completed their junior year participated.

The new AIM has two primary objectives: to immerse high school students in the typical schedule of daily activities at USCGA and to increase the engineering and technological literacy of the participants. The second objective is achieved through an engineering component in which the high school students work in teams throughout the week to build a radio-controlled floating robotic craft. The teams compete against each other at the end of the program by completing Coast Guard related tasks with their creation. Feedback on the first summer of this new program from faculty, cadets, and participants has been overwhelmingly positive.

THE NEW AIM

At the core of the Academy's recruiting effort is getting high school students on campus. The AIM program not only achieves this goal but also goes further by giving high school juniors the opportunity to experience cadet life for six days. Participants sleep in the barracks, eat in the cadets' dining facility, are organized in a military structure, and participate in academic, military, and athletic activities each day.

During the first two years of this new AIM, there have been approximately 1,000 applicants each spring with about 500 accepted for the summer program and attending during one of three weeks. The participants pay \$325 to attend, which covers most of the costs incurred by the institution to implement the program. Scholarships for both this amount and/or travel are available. Historical data from the AIM program shows that 70% of those who attend AIM will apply to USCGA and between 25% and 35% of the incoming freshman class are previous AIM participants.

To supervise students and coordinate daily activities, about 40 cadets (juniors and seniors) are involved in the summer program, which includes the three different weeks of AIM as well as one week of preparation. During this preparation week, cadets are trained specifically on the engineering component of AIM and complete the engineering project themselves. Faculty members are also an important part of AIM. Engineering faculty members are assigned to a group of students for the week and advise them during the engineering project. While time consuming, the engineering faculty are nevertheless committed to this involvement in AIM and interacting with the high school students on a significant basis. The admissions division at USCGA coordinates the AIM program including the advertising, enrollment, and daily

activities. Engineering faculty and staff are responsible for the engineering component.

THE ENGINEERING COMPONENT

The most significant change in this new AIM program is its engineering focus. On the first day, students are introduced to the engineering majors at USCGA and the problem solving process. Subsequently the students spend significant time working on an engineering project throughout the week.

I. Introducing Engineering Design

The problem solving process used at USCGA throughout the undergraduate curriculum is taught to the AIM students and used during the engineering project to stress that engineering design is a process. The same process is used not only in engineering classes but is also used in some freshman level classes in other departments [1]. This six-step problem solving process is identified by the acronym DRIDS-V:

- Define
- Research
- Identify
- Decide
- Solve
- Verify

A cadet and faculty mentor assigned to each team of students assist in ensuring the design process is followed during the entire week. Students are required to define the problem and identify the constraints and evaluation criteria. They learn about the problem and gather information including any assumptions. Through brainstorming, alternate solutions are identified and the best solution is decided upon. The solution is then implemented and verified to ensure that it adequately solves the problem.

II. The Engineering Project

The primary focus of AIM is an engineering project in which the high school students work in teams to build a radio-controlled floating robotic craft. The culmination of the AIM program occurs on the last full day when the teams compete against each other by completing Coast Guard related tasks with their creation.

Using the FIRST Robotics Competition as inspiration, the engineering faculty and staff created a project in which the design and building of a floating robotic craft occurs during multiple sessions throughout the week. Each team of students is supplied with a robotic parts kit that includes a radio transmitter and receiver. The goal behind the project selection was to ensure that all of the four USCGA engineering majors were represented: Civil Engineering, Electrical Engineering, Mechanical Engineering, and Naval Architecture & Marine Engineering. Creating a project that was Coast Guard related enhances the entire AIM experience.

At the end of the program, a competition between teams evaluates how well each team was able to design and build a robotic craft that met each of the given criteria. Parents of

participating students and faculty are invited to attend this exciting event.

PRELIMINARY RESULTS AND FUTURE EVALUATION

Based on subjective criteria, the first year of this new summer program was an overwhelming success in terms of introducing high school students to both USCGA and engineering. Faculty, cadets, students, and parents all had positive reviews of the program. At the end of the six-day experience over 50% of the participants had interest in becoming an engineer. In addition over 50% of the participants indicated that they were likely to accept an appointment to USCGA if offered.

Many colleges and universities offer a summer engineering experience. Observations of a successful summer engineering program at Widener University [2] are also seen here in the AIM program. These observations include avoiding lectures, promoting team building, having competition, and employing activities with a visual aspect.

Statistics show that high school students who were not accepted to the AIM program generally do not apply for admission to USCGA. Special attention is now given to these qualified students who were unable to gain AIM acceptance due to space restrictions. The students are contacted by faculty or staff and offered a special overnight campus visitation in the fall of their senior year of high school.

The class of cadets enrolled in the 2005-2006 academic year is the first to have participants from the new AIM program. An objective evaluation of the program will consist of tracking the first AIM participants as well as AIM participants in future USCGA classes and their selection of major and retention in that major. Consequently, future enrollment in engineering majors will be compared with historical norms.

CONCLUSIONS

The Coast Guard Academy is fully committed to its new summer Academy Introduction Mission program. In the past, the program has been very successful in recruiting and retaining cadets in all majors. A new engineering component of AIM informs students about engineering majors at USCGA, introduces an engineering design process, and has an engineering team project culminating in an exiting competition. With these significant changes implemented this past year, it is anticipated that evidence will soon show that the new AIM program is also successful in *engineering* recruitment and retention.

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